TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVEMENTS TO ECOLOGICAL RISK ASSESSMENTS AND ANALYSIS OF POPULATION-LEVEL IMPACTS

Identification No.: RL-SS43
Date: September 2001

Program: Environmental Restoration
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit(s): Broad need potentially applicable to multiple operable units.
PBS No.: RL-SS04 (RL-VZ01)
Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3]
TSD Title: N/A
Waste Management Unit (if applicable): N/A
Facility: N/A

***Priority Rating*:**

This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" priority:

X 1. Critical to the success of the ACPC
___ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
___ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

***Need Title*:** Improvements to Ecological Risk Assessments and Analysis of Population-level Impacts

Need/Opportunity Category: Technology Need

***Need Description*:** This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an "integrated" need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of the water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this "integrated" need summarizes a number of S&T components that together address a specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific

technology need can be defined separately from an "integrated" need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

Techniques, technologies, and information that reduce uncertainty in current risk assessments and more-directly address applicable ecological risk guidelines and regulations are needed to address ecological risks posed by contaminants at Hanford. Current techniques and information are insufficient to predict accurately individual exposures to contaminants, especially where food chains and nutrient analogues are involved, and the effects from this exposure. Thus, conservative assumptions are required that increase uncertainty in the assessment results.

Besides requirements to understand exposures and effects at the individual level, guidelines and regulations are increasingly requiring estimates of risk to populations and ecological functions (Durda and Preziosi 1999). For example, regulations under the Endangered Species Act require assessing individual risks for endangered species, as well as estimating risks for the survival of that species. However, there is insufficient knowledge to characterize population exposures to contaminants and the effects such exposure might have on population processes. Specific needs to address these technical gap include the following:

- Exposure-related information needs:
  - Exposure scenarios for specific species groups that are important to food webs at Hanford (for example, data on the relative exposure to surface waters and pore waters of benthic invertebrates in the Reach is not known, nor is the relative uptake from vadose vs. groundwater by deep-rooted riparian plants).
  - Toxicokinetic/toxicodynamic models to predict the body burdens of contaminants under spacio-temporally varying exposure conditions in multiple media.
  - Methods to predict relative bioavailability of contaminants in multiple media for a diverse set of organisms.
  - Methods to measure temporally-varying exposures of aquatic organisms that use areas larger than the area affected by contaminants.
  - Techniques are needed to reduce the uncertainty associated with extrapolation of toxicological parameters across taxa.
- Response-related information needs
  - Toxicokinetic/toxicodynamic models to predict effects of multiple Hanford contaminants on key species
  - Statistical methods and data to more-accurately extrapolate responses measured in one species to responses in other species
  - Methods and data to estimate effects of exposures on populations and ecosystem processes, including direct effect approaches, population dynamics models, and ecosystem process models.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE 2000) indicates that the information is required to be implemented as part of the System Assessment Capability, Revision 2. In addition, information associated with key contaminants (e.g., strontium-90 and hexavalent chromium) in the aquatic environment are required for decisions associated with the remediation activities in the 100 Areas by FY 2004 timeframe.

***Problem Description*:** This need falls under the Risk Technical Element within the S&T Endeavor. The Risk Technical Element will provide an assessment of the potential risks to the environment, human health, economic and socio-cultural quality of life from Hanford-derived contaminants. Ecological risk assessments include four phases in the evaluation: problem formulation, exposure characterization, ecological effect characterization, and risk characterization (EPA 1998). This need addresses all four phases of ecological risk assessment and the approaches for fulfilling the need will improve the accuracy, precision and utility of ecological risk assessments at the Hanford Site and throughout the DOE complex.

Benefit to the Project Baseline of Filling Need: Ecological risk assessments are to be required for remediation decisions in the upcoming changes in Washington State's Model Toxics Control Act. These changes include impacts to populations.

***Functional Performance Requirements*:** The application of the knowledge gained through the performance of the specific needs must address the Hanford contaminants and species of interest. The information must result in a better understanding of the uncertainty in current assessments and address upcoming changes in guidelines and regulations.

Work Breakdown Structure (WBS) No.* :** 1.4.03.4.4 ***TIP No.: TIP-0016

Relevant PBS Milestone: PBS-MC-042

***Justification For Need*:**

Technical: There currently is insufficient information to address population-level impacts and specific toxicological data to support assessment of many Hanford species. In the absence of the information addressed in this need there is high uncertainty in current ecological risk assessments.

Regulatory: This need specifically addresses EPA guidelines and upcoming changes to Washington State's Model Toxics Control Act on population-level risk assessments. The information obtained by addressing the need will provide an improved technical basis for making decisions.

Environmental Safety & Health: This need specifically addresses environmental safety and health issues across the Hanford Site.

Potential Life-Cycle Cost Savings of Need (in $000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is $200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This need supports cultural and stakeholders concerns to address ecological impacts that were expressed in "Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment" (DOE 1998). Ecological risk information that is specific for the species that are of most concern are specifically addresses in this need.

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

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DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

References:

Durda, J.L., and D.V. Preziosi, 1999, Where's the Population in Your Risk Assessment?, *SETAC News*, November 1999. Society for Environmental Toxicology and Chemistry.

DOE, 1998, *Screening Assessment and Requirements for a Comprehensive Assessment: Columbia River Comprehensive Impact Assessment*, DOE/RL-96-16, Revision 1, U.S. Department of Energy, Richland, Washington.

United States Department of Energy. 2000. Groundwater/Vadose Zone Integration Project Science and Technology Summary Description. DOE/RL-98-48, Vol. III, Rev. 1, U.S. Department of Energy, Richland, Washington.

EPA, 1998, *Guidelines for Ecological Risk Assessment*, EPA/630/R-95/002F, U.S. Environmental Protection Agency, Washington, D.C.